The influence of a cold period in the development of the embryo of *Clonopsis gallica* (Charpentier).

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Abstract

An experiment with *Clonopsis gallica* (Charpentier) shows the differences in egg development and hatch rate between eggs having undergone a cold period and eggs being kept at a constant room temperature. The onset of hatching is delayed by a cold period during incubation but the total number hatching is unaffected.

Key words

Phasmida, Phasmatodea, diapause, egg development, *Clonopsis gallica*.

Material

Three adult females of *Clonopsis gallica* (Charpentier) were obtained on the 23rd of April 1995 from captive reared stock from Gert Baarda, at a meeting of the Dutch/Belgian group Phasma. When I arrived home, I started feeding them bramble and rose, they were never sprayed and there was no soil covering on the floor of the cage. Consequently, the eggs were always dry, being at an atmospheric relative humidity of 50-60%. The temperature was constantly between 19°C and 23°C, only varying slightly between day and night.

All the females died the same week, on the 7th of August 1995 the last female died. Then I collected all the eggs, kept exactly 200 of them and gave the rest away to interested breeders.

Method

The 200 eggs were split (at random): 100 which would undergo a cold period (constantly at 10-12°C) for three months of their development, and 100 were kept at constant room temperature (at 19-23°C) during the whole development.

Half of the 200 eggs were put into a black photographic film tube, which was put into the cellar at 10-12°C, day and night. The other 100 eggs were used as a control group and put into an identical box in my bedroom, at a temperature between 19°C and 23°C.

On the 2nd of November 1995 the eggs having undergone a cold period were taken into my bedroom and put onto a slightly humid layer of soil in a transparent box of 15 x 7 x 7 cm. At the same time, the 100 eggs in the control group were also incubated at exactly the same way. The two incubation boxes were put next to each other in ambient conditions (no direct sunlight, no extra heating, etc.). Further, the two boxes were treated at the same way: wetting the soil in both boxes at the same time and with about the same quantity of water.

The first nymphs hatched on the 4th of December 1995. From then on each hatched nymph was noted around 0800 each day. On the 25th of February 1996 the last nymph hatched. The eggs were kept in the boxes for several months more, but no more nymphs were seen.

Results

The results are recorded in table 1, and are shown on Graph 1 so that the rate of hatching is clearly seen.

Discussion

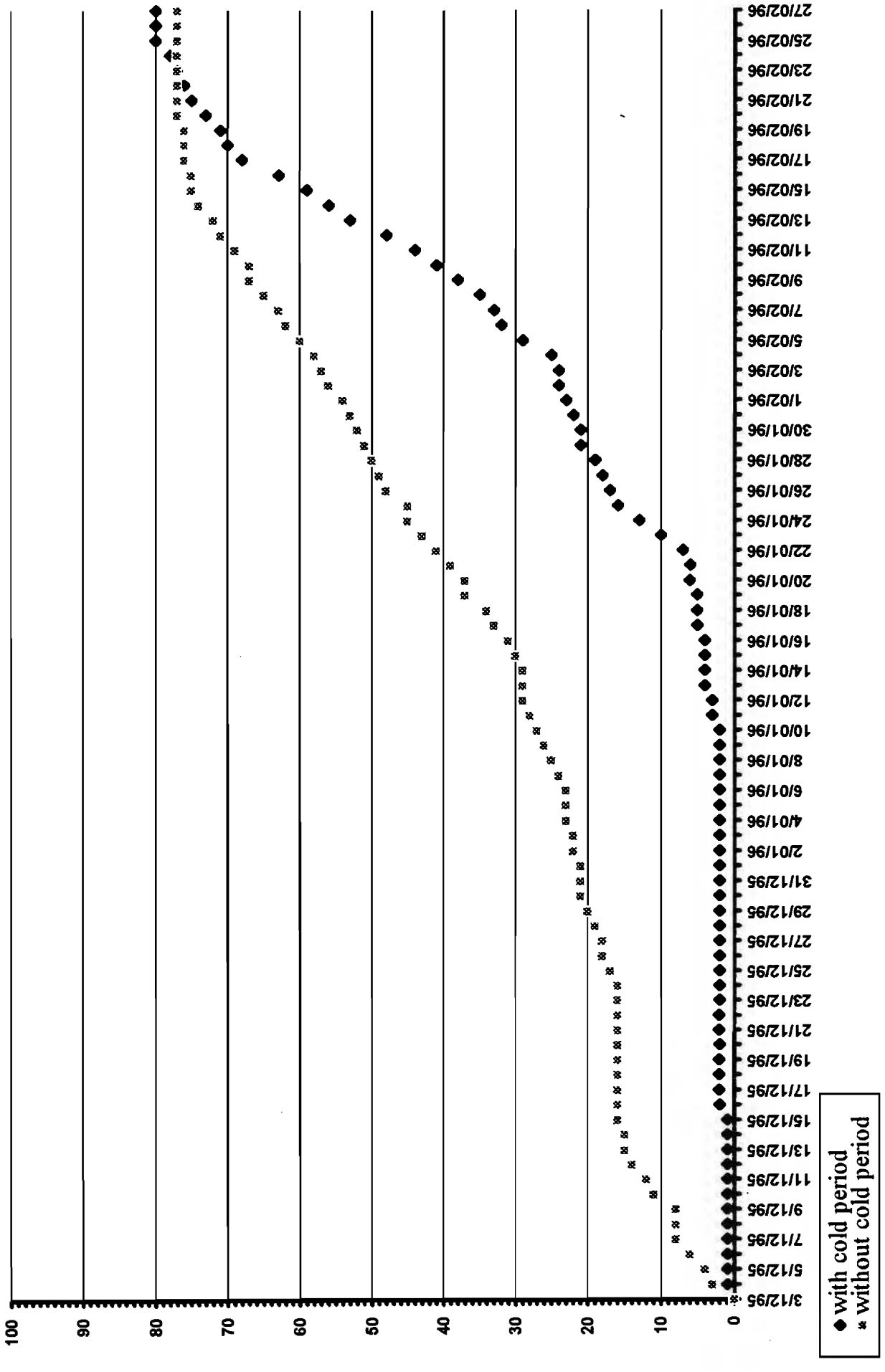
We see from the graph that the rate of hatching of the eggs in the control group is more linear than the cooled group. The nymphs start hatching at a certain day and continue at a more or less constant hatching rate, which agrees with the constant egg laying rate of the adult females. This means that each embryo takes about the same time to develop. At a certain day the hatching suddenly stops, just as the egg laying had suddenly stopped because

of the death of the adults.

	With cold period			Without cold period		
	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.
Day	1995	1996	1996	1995	1996	1996
1	0	0	1	0	0	2
1	0	0	1	0	1	2
3	0	0	0	0	0	2
4	1	0	1	1	1	1
5	0	0	4	1	0	2
6	0	0	3	2	0	2
7	0	0	1	2	1	2
8	0	0	2	0	1	2
8	0	0	4	0	1	2
10	0	0	3	3	1	1
10	1	1	3	1	1	2
12	0	0	4	2	1	2
13	0	1	5	1	1	1
14	0	0	3	0	0	1
15	0	0	3	1	1	1
16	1	0	4	0	1	0
17	0	1	0	0	2	1
18	0	0	1	0	1	0
20	0	0	1	0	3	0
20	0	1	2	0	1	1
21	0	0	2	0	2	1
22	0	1	1	0	2	0
23	0	3	1	0	2	2
24	0	3	1	5	2	0
25	0	3	2	1	0	0
26	0	1	0	1	3	0
27	0	1	0	0	1	0
28	0	1	0	1	1	0
29	0	2	0	1	1	0
30	0	0	-	1	1	-
31	0	1	-	0	1	-

Table 1: Number of nymphs hatching from each group of eggs.

Graph 1: The total hatching rate as function of time.



Contrary to this, the curve for the cold group is more sigmoidal. Hatching starts very slowly and the hatching rate per day grows to a maximum, which makes the curve steeper. Once this maximum is reached, the hatching rate decreases and finally becomes zero, so that the curve flattens again. The curve has a flattened S-shape, typical of a sigmoid curve.

It is remarkable that in both boxes the nymphs started hatching exactly at the same day. This should be seen as a coincidence as the cooled group still stays at one hatched nymph when the control group has already passed the ten first hatchings, so the first nymph of the cooled group may be disregarded.

Near the end the curve for the cooled group passes the control group and remains above it. However, the final difference is not large. The total hatching percentage of the eggs being kept at a constant temperature is 77%. The total hatching percentage of the eggs having undergone a colder period is only slightly higher (80%), so we can conclude that the influence of a cold period on the total hatching percentage is almost nil.

Conclusion

Discounting the first nymph of the cooled group, we can see that this group starts hatching about six weeks later than the control group. As the cold period was at a different stage for different eggs, some eggs might already have completed their diapause before going into the cold. Therefore we should not see the cold period as obligatory diapause, but rather as a slow-down of the general development, which explains why the cold group starts hatching later.